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DEVELOPMENT AND EVALUATION OF A STRESS SKIN/POST TENSION WALL SYSTEM: FINAL REPORT

6521-12-89

HOUSING TECHNOLOGY INNOVATION PROGRAM

FINAL REPORT

DEVELOPMENT AND EVALUATION OF A STRESS SKIN/POST TENSION WALL SYSTEM

PREPARED BY: SYLVAPRO INC.

Under the responsibility of:

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January 15th, 1990

DEVELOPMENT OF A STRESS SKIN/POST TENSION WALL SYSTEM

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DEVELOPMENT OF A STRESS SKIN/POST TENSION WALL SYSTEM

1. INTRODUCTION

1.1 The basic idea

This is the conclusion on the development and evaluation of a stress skin/ post tension wall system.

A "monocoque" light and rigid type of wall, composed of a 5" thick expanded polystyrene panel acting as the core as well as the thermal insulation requirement (note that the thickness of insulation panel could vary upon requirement). Two skins or surfaces made of 1/4" thick wafer board panels reinforced with 5/8" x 1 1/2" wafer board, vertical wafer board strips located at 16" c.c. are applied to both surfaces (inside and outside) and glued (see dwg #1).

A fiber glass tension rods system is introduced through the wall, at reinforcing strips and at 16" c.c. both ways. (see dwg #4). By means of tapered holes in the wood surfaces and special plastic locks, the fiber glass rods (1/8" dia.) are pulled out and panel compressed at the same time creating a uniform and permanent pressure from the skins towards the central polystyrene core (see dwg #4). Note that during the post tensionning operation the polystyrene core is compressed at approximately 5% in both direction length and width.

The top and bottom of the wall are capped with a full 5/8" thick wafer board and straight angle strips all R.F. glued and stappled together under uniform pressure. (see dwg #1). The wall units are made in dimensions of 8' 1 1/2 x 16' and from full size wafer board sheet which can be re-cut to desired dimensions on construction sites.

Any openings less then 4' wide can be cut within the panel, for openings wider than 4', a special lintel as well as jamb reinforcing is available (see dwg #3). A special corner has been developed (see dwg #5) which facilitates the installation. The polystyrene insulation is left in excess of the wood frame by about 3/16" assuring a perfect sealing gasket to joints when tightening the three interior bolts and outside screws.

The drawing #2 shows the method of jointing two panels together. Note that three rows of slots are perforated through the vertical wood strips to facilitate passages of electric wiring.

1.2 The potential benefit the the housing industry

A number of construction methods have been used in the past, the most popular being the 2" x 4" or 2" x 6" frame which require several phases of operations to achieve a good quality of wall, and the constant increases in labour cost make this method expensive. Furthermore, the fluctuation of climatic conditions as well as difficult control could influence by much, the quality of this type of wall.

During the last decade, a pre-fab type of wall made of wood frame combined with polystyrene panel was put on the market place with a reasonable success, even if its quality was questionable since its limited resistance on different aspects such as thermal, torsion and shear as well as its vulnerability to damages during handling and the fact that it requires additional sheeting and bracing protection, makes the complete wall expensive.

The only method that is the nearer from our system is the polyurethane foam stress skin sandwich panel. However, this material is very noxious and expensive. It also requires some means of reinforcing to make it a complete structural wall which brings the end product at a prohibitive price.

DEVELOPMENT OF A STRESS SKIN/POST TENSION WALL SYSTEM

Our stress skin/post tension system is a complete wall, that combines a high structural value in all aspects such as load, torsion, shear and flexion, added to a high resistance to deterioration in transport or handling. Its thermal and air infiltration resistance is stable in permanence, because of its full size skin protection and the all direction post tension of the insulation during fabricating process. A single and ingenious method of automated manufacturing added to the maximum use of the material physical properties, make it a very economical wall system and a top quality product. Compared with the average cost of a conventional site built wall the saving could be at least of 25%.

However, the construction industrywould benefit on many other aspects such as time saving and guaranteed quality under any climatic conditions.

2. METHOD

2.1 Phase I

Under this first phase, the overall design was elaborated and various connections and components were developed and experimented and more specifically design of different panel arrangements. Differently composed and full scale panel prototypes were built for physical testing and observations.

Different type of tension rods and clamps were explored and evaluated.

2.2 Phase II

This second phase consisted in testing differently composed prototypes. Testing consisted in load and flexion resistance and more particularly the performance of the post tension rods combined with the associated participation of the stress skin effect. The other elements completing the overall load resistance and flexion capacity being the combination between the skin itself and the polystyrene which contributed significantly, since the first is being glued and post tensionned one to the other through the core and the polystyrene being compressed and enclosed within a rigid surface from all directions.

The design was then corrected to accommodate the variations observed during the testing sessions.

2.3 Testing and demonstration

Post tension rods

Several types of plastic composed rods have been experimented and did not perform satisfactorily. However the fiber glass rods that were finaly found and adopted are really the optimum in tension resistance. The smallest produced 1/8" dia. is graded at 1 400 pound capacity which is about three times the resistance required. Its thermal conductivity is neutralized by its tight passage through the insulation and the sealing of both ends.

Load bearing and lateral flexion

The load bearing testing which was conducted on two different 4' x 8' prototypes has proven a load and lateral flexion resistance much higher than expected (see Engineer's report dated Dec. 28/89).

3. RESULTS - PHASE III

3.1 Conclusion

The execution of the present research program has given us the opportunity to explore, experiment and test the different physical properties and other aspects of this system and proven its pertinence.

Its top quality, convenient aspects and its facility to handle and install as well as its very competitive price will no doubt, make it a very popular construction component.

LES LABORATOIRES DE L'ESTRIE INC.
Etudes géotechniques - Inspection - Essais - Analyses

Granby, le 28 décembre 1989

M Raymond Couture
Sylvapro inc.
30 des Fresnes
Bromont, Qc.
J0E 1L0

Sujet: Essai de résistance de portée
Systeme de mur "Stress skin Post tension"

Monsieur,

a votre demande nous avons assistés à votre atelier de Bromont le 22 décembre 1989 à des essais de résistance (capacité de portée) sur deux échantillons de mur de 4'X 8'X 6 3/4"

Composition des échantillons:

- 1 panneau de polystirene de 5" d épaisseur
- 2 panneaux gauffrés OSB de 1/4" d'épaisseur, tringlé aux 16" c.c. avec des lisières de panneau gauffré de 5/8"X 1 1/2" et fermé en haut et bas avec un panneau gauffré de 5/8"
- l'adhésif utilisé pour le contact bois-bois était du "phénol résorsinal" tandis que le contact "bois-styrene" était du PVC
- les tirants de précontraintes faient de résine et fibre de verre étaient de 1/8" de diamètre et de 1400# de résistance tension et localisés à 16" c.c. dans les deux sens.

...2

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Systeme d'essai utilisé:

Un appareil à pression hydrolique monté en position verticale et muni d'un gauge à pression fiable.

Essai:

Deux prototypes ont été soumis aux pressions suivantes:

	Pression verticale (largeur 4' 0")	Pression latéraie (surface 32c.)	Déflexion verticale	Déflexion latérale
Prototype #1	16000#	1000#	3/32" après 1 heure	3/16"
Prototype #2	20000#	1000#	1/8" après 6 heures	1/4"

Nous n'avons noté aucun signe de faiblesse sur les tirants qui semblent beaucoup plus forts que requis, ce qui est d'allieurs avec l'hadésif l'élément le plus important.

Aucun signe de voilement ou faiblesse sur l'ensemble du panneau n'a été noté.

Nous n'avons pû nous rendre jusqu'à la rupture, la capacité du système hydrolique utilisé ne le permettait pas.

p.j.

Toutefois les résultats obtenus permettent de conclure que ce type de panneau peut très bien convenir sécuritairement à un édifice de deux étages et de légères modifications peuvent en accentuer sensiblement sa capacité.

Nous n'avons pas exécuté d'essai en cizaillement mais il n'y a aucun doute qu'un tel système de mur comporte des résistances en cizaillement qui dépassent de beaucoup les besoins.

Nous espérons que ce rapport d'observation est à votre entière satisfaction. N'hésitez pas à communiquer avec nous si des informations supplémentaires vous étaient nécessaires.

Veuillez recevoir Monsieur l'expression de nos sentiments les meillieurs,

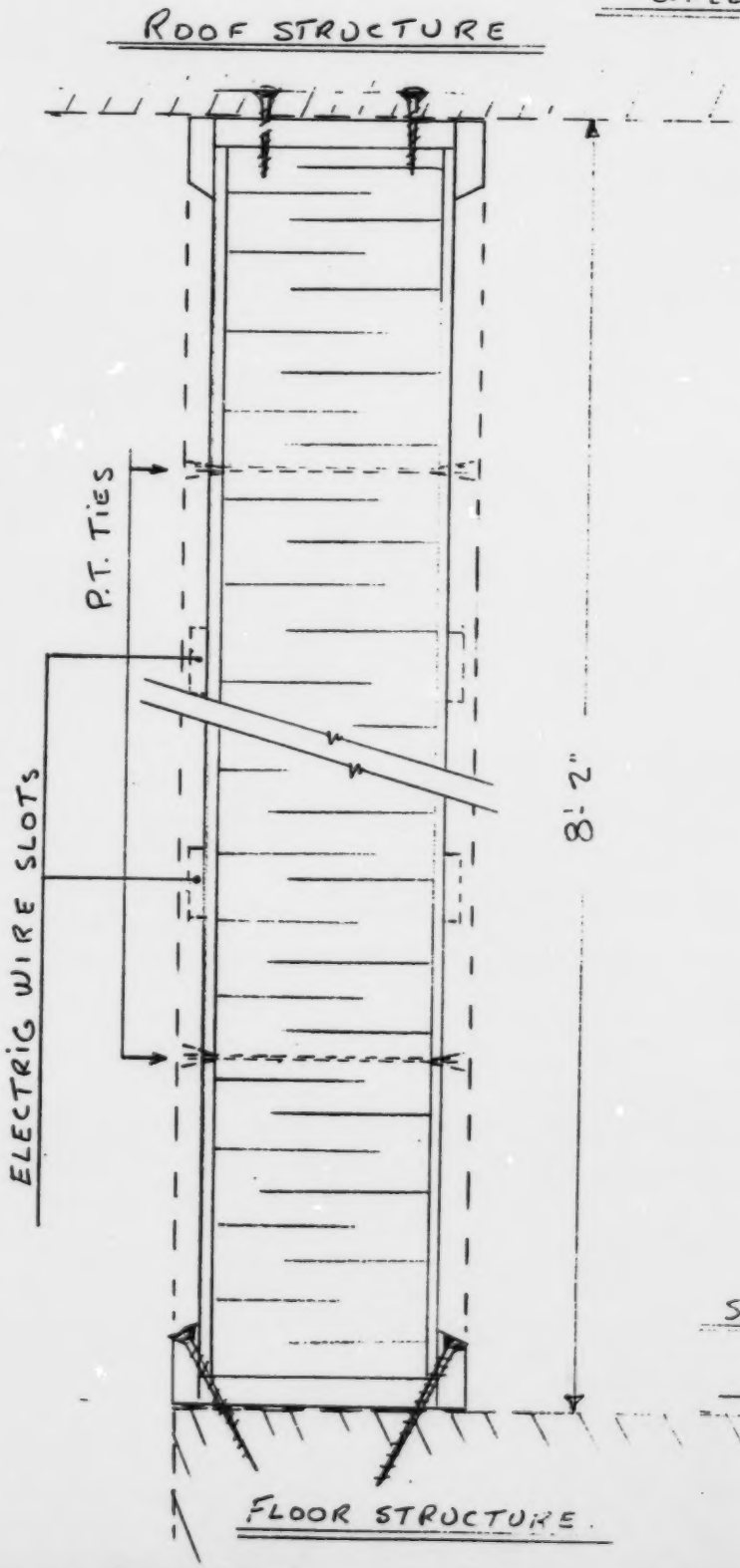
Jean Authier, ing., M.Sc.A.
Directeur technique

JA/pf

p.j.

TOP & BOTTOM CONNECTION

SCALE: 3" = 1'-0"



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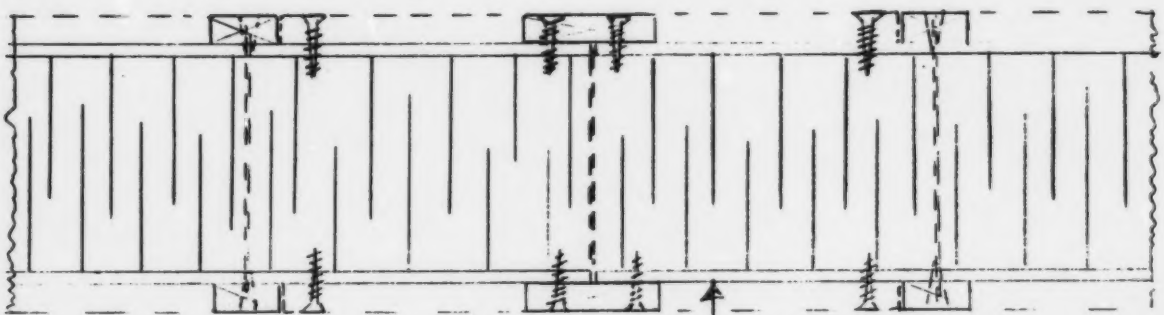
STRES SKIN POST TENSION

WALL SYSTEM

DRAWING NO 1

PAT PENDING. ALL RIGHTS RESERVED.

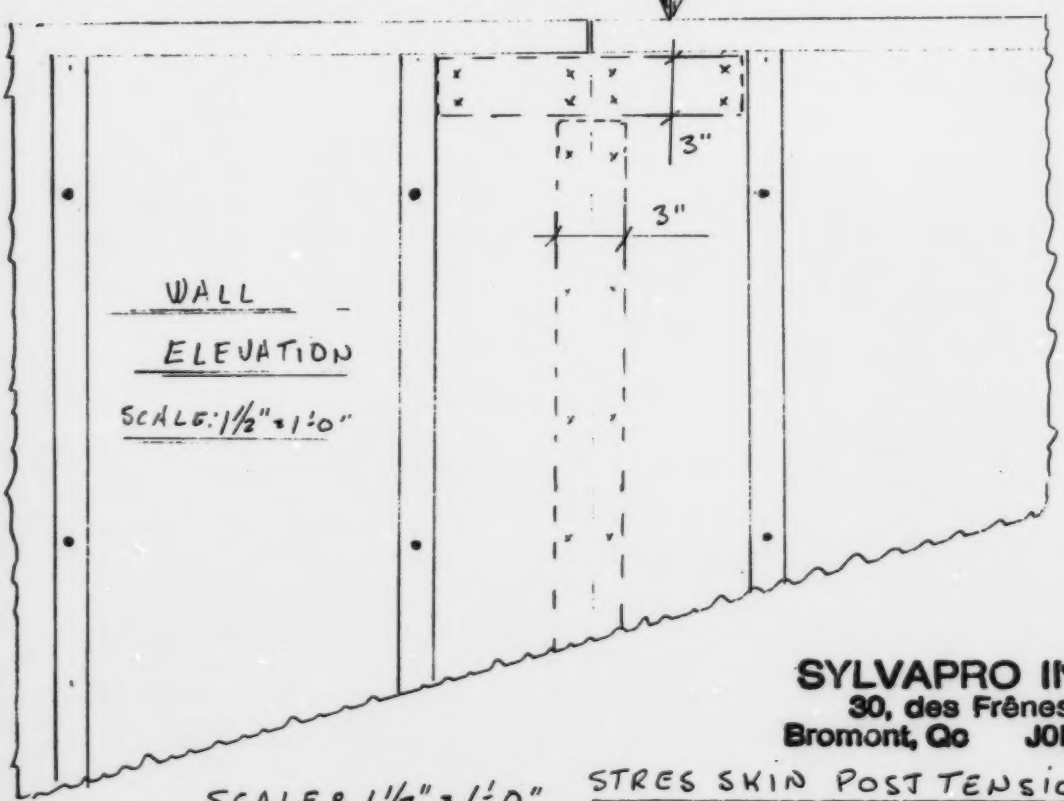
CONNECTION BETWEEN WALL SECTION



SCALE: 3" = 1'-0"

CROSS SECTION

16" 16" ±



WALL ELEVATION

SCALE: 1½" = 1'-0"

SCALE & 1½" = 1'-0"

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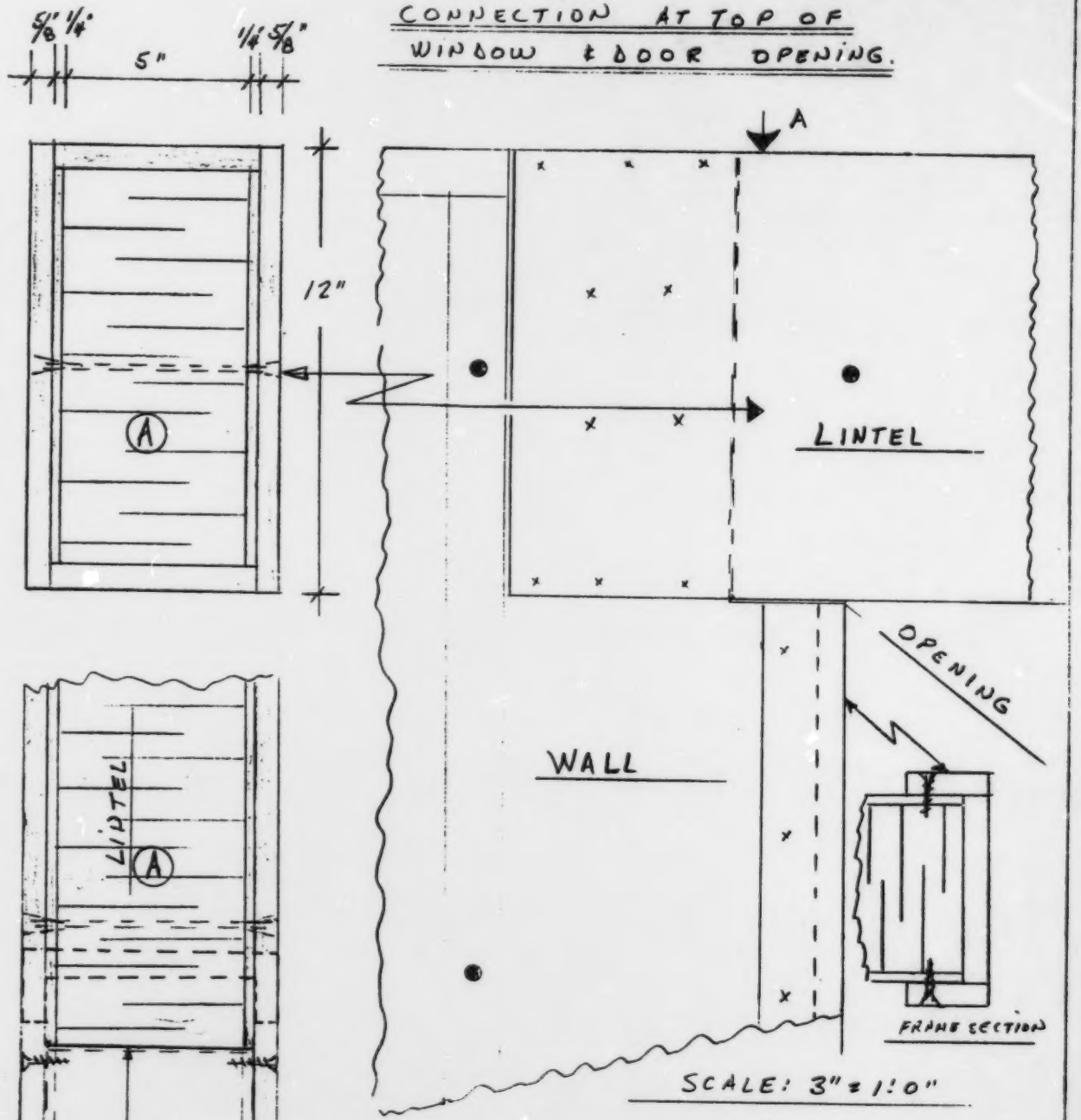
STRES SKIN POST TENSION WALL SYSTEM

DRAWING NO 2

PAT PENDING ALL RIGHTS RESERVED



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STRESSKIN POSTTENSION

WALL SYSTEM

DRAWING NO 3

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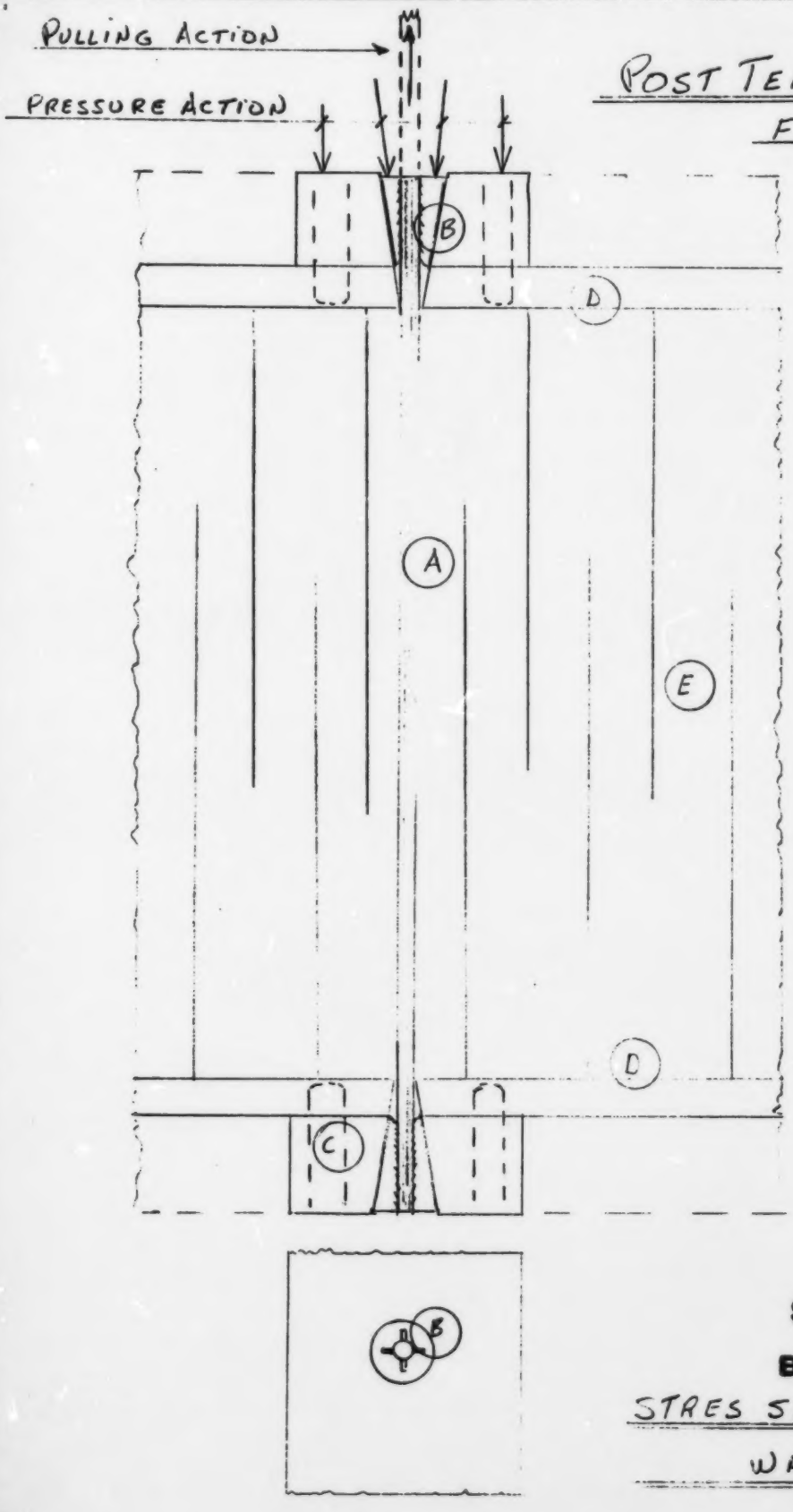
POST TENSION SYSTEM

FULL SCALE



(A) FIBER GLASS ROD 1/8" ϕ

(B) PLASTIC TAPER LOCK

(C) REINF'G STRIP

(D) W.B. PANNEL

(E) POLYSTIRENE INSUL'N

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STRES SKIN POST TENSION

WALL SYSTEM

DRAWING NO 4

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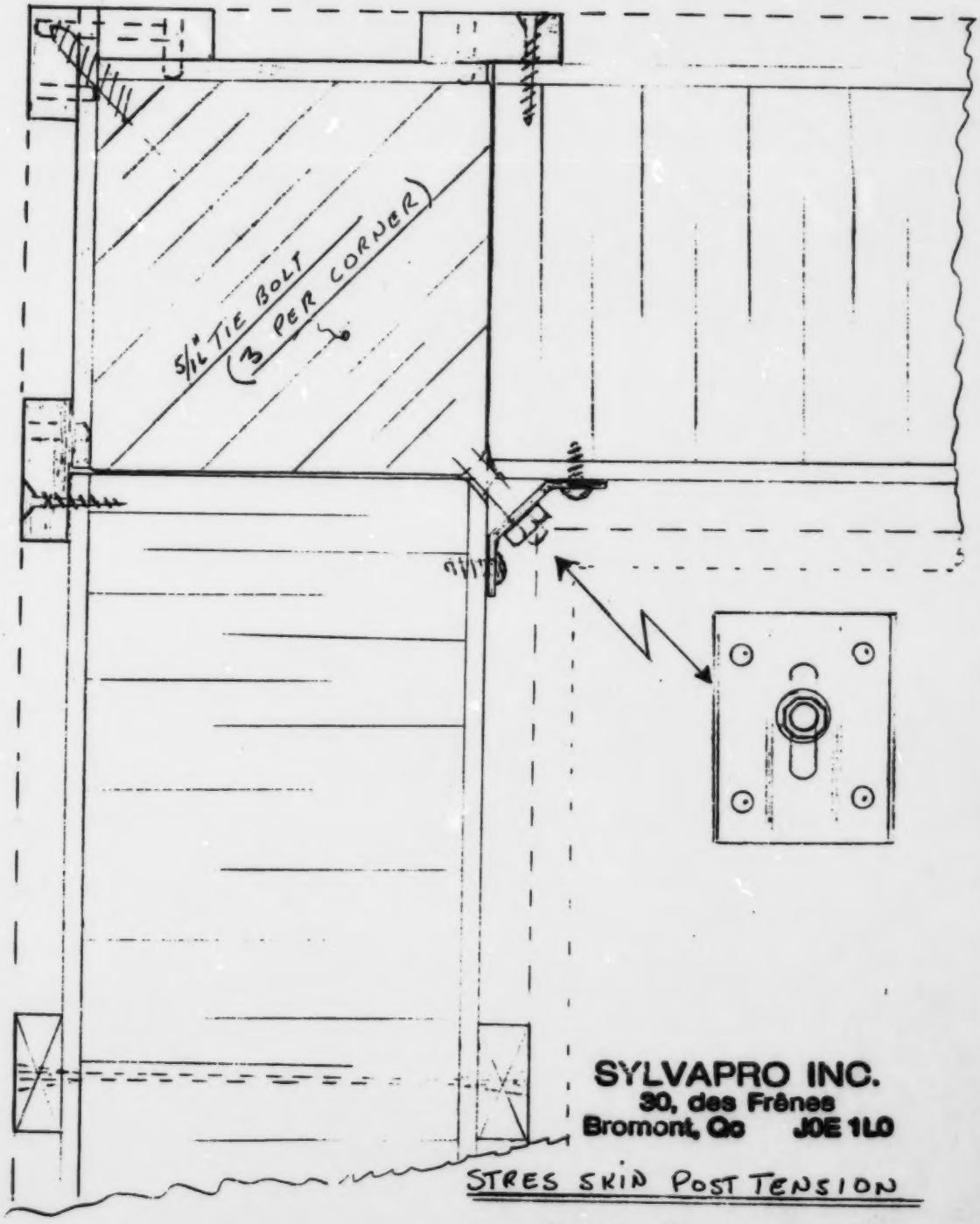
CORNER DETAL

SCALE 8 HALF FULL



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STRES SKIN POST TENSION

WALL SYSTEM.

DRAWING NO 5

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